Corrosion behaviour of pulse electrodeposited Nickel based composite coatings

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Abstract

Ni-SiC composite is widely adopted as a functional coating in aerospace and automobile applications. However, the limitation with this coating is that at temperatures above 400^{o}C nickel reacts with silicon carbide to form brittle silicides which deteriorates the performance of the coating. Oxides are thermally more stable than carbides and hence, in the present study an attempt has been made to compare the corrosion behaviour of pulse electrodeposited Ni-ZrO_2 and Ni-YSZ coatings with Ni-SiC coatings in 3.5%NaCl medium. The three composite coatings were deposited under identical conditions i.e.10% duty cycle and average current densities in the range of 400-700mA/inch^2. The microhardness of Ni-YSZ coating was higher than that of Ni-ZrO_2 and Ni-SiC coatings. The corrosion behaviour of the coatings was evaluated using polarization and electrochemical impedance studies in 3.5wt%NaCl medium. The Ni-YSZ coating displayed better corrosion resistance due to low corrosion current density (i_{corr}) and high polarization resistance (R_p) compared to Ni-ZrO_2 and Ni-SiC composite coatings. The icorr values at constant average current density of 400mA/inch^2 are 0.1µA/cm^2, 3.9 µA/cm^2 and 14.6 µA/cm^2 for Ni-YSZ, Ni-ZrO_2 and Ni-SiC coatings respectively. The charge transfer resistance (R_{ct}) was the highest for Ni-YSZ coating affirming the above behaviour.

Keywords: Ni-composite; Corrosion; Polarization studies; Electrochemical Impedance Spectroscopy

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